DOCUMENT RESUME

ED 314 278 SE 051 153

AUTHOR Zolg, Carolyn; Tanner, Joey, Ed.
TITLE Astronomy: Self-Directed Study Units for Grades K-3 and 4-8, Gifted. Easily Adapted for Regular Classroom Use. Zephyr Learning Packet.
REPORT NO ISBN-0-913705-02-0
PUB DATE 82
NOTE 80p.; For other units in this series, see SE 051 154-162. Revised Edition.
AVAILABLE FROM Zephyr Press, 3865 East 34th Street, Suite 101, Tucson, AZ 85732-3448 (ZP10-R, $16.95).
PUB TYPE Guides - Classroom Use - Materials (For Learner) (051) -- Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Astronomy; Elementary Education; *Elementary School Science; *Gifted; Instructional Materials; Interdisciplinary Approach; Junior High Schools; *Middle Schools; *Science Activities; Science Education; *Secondary School Science; Space Sciences

ABSTRACT

Originally designed for gifted students, these reproducible astronomy units emphasize the use of higher order thinking skills and are appropriate for use in any classroom. Interdisciplinary in content, the units provide a broad view of astronomy. Included are two complete units, one created for the upper elementary gifted student and the other for the lower elementary gifted student. Suggestions for adapting the materials to fit other classrooms are included. Several learning modalities are designed into the materials to encourage active student participation. (CW)

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Self-Directed Study Units for grades K-3 and 4-8, gifted

A SELF-DIRECTED LEARNING EXPERIENCE
Interdisciplinary – Product Oriented
Grades K – 8

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Researched and developed by
Carolyn Zolg
Edited by
Joey Tanner

Self-Directed Study Units for grades K-3 and 4-8, gifted

easily adapted for regular classroom use

Interdisciplinary and
Product Oriented
through the use of:

- Evaluating
- Classifying
- Comparing
- Imagining
- Researching
- Mapping & Charting
- Creating
- Reporting
- Thinking . . . Reacting
- Career Exploration

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TUCSON, ARIZONA

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REVISED EDITION 1982

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Illustrations: Deborah Franks
Book Design: Penny Rebholz

Printed in the United States of America

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THE PREMISE

CHILDREN ARE ACTIVE PARTICIPANTS IN THEIR LEARNING, NOT PASSIVE VESSELS TO BE FILLED. THEY ARE ALWAYS SEEKING AND CHOOSING WHAT THEY WILL LEARN AND WHAT THEY WILL NOT LEARN. THEIR ACTIVE INVOLVEMENT IS CRUCIAL TO LEARNING. CHILDREN TEND TO BECOME PERSONALLY INVOLVED IN PROJECTS THAT APPEAL TO A VARIETY OF MODALITIES . . . READING, WRITING, BUILDING, CREATING, IMAGINING, AND REAL THINKING . . . SO A VARIETY OF EACH IS INCLUDED IN THIS SELF—DIRECTED LEARNING UNIT.

A WORD TO THE TEACHER

ASTRONOMY

From ancient times when man believed planet earth to be the center of the universe, the earth to be flat, and the sky to be a huge dome above, man has studied the heavenly bodies and the space between them.

One of the oldest true sciences, Astronomy, is the study of the nature, motion, and distribution of these heavenly bodies.

In the early days, the location of the stars, was used to tell the best time to begin a battle, where to build a pyramid, when to plant seeds for the best crops or how to reach a distant land.

Today, the rapid development of new techniques and instruments has given us a great accumulation of knowledge about the earth, our solar system, and the universe. Space travel has allowed man to accurately determine the shape of the earth, to study space without interference of the atmosphere, and to study the earth from space.

Many questions about our universe remain unanswered. Future astronomers may find intelligent life on other planets or the answer to age old questions about the beginnings of the universe.

"ONE CAN LEARN THE CAMPAIGNS OF THE CIVIL WAR WITH DATES, BATTLES AND CHARACTERS WITHOUT LEARNING ANYTHING ABOUT WHY WARS ARE FOUGHT BETWEEN FRIENDS OR WHAT IDEAS CAN BE GENERALIZED TO OTHER CONFLICT SITUATIONS."

James Gallagher,
Teaching the Gifted Child, 1974

RATIONALE FOR SELF-DIRECTED LEARNING

Our children's education must be more than the memorization of capitols of the states, the products of countries and the dates and places of past wars. Most teachers and parents would agree that what is also wanted is for children to learn to think for themselves, to organize their own time, to make wise choices, to work independently and to thoughtfully evaluate the results of their study.

OBSTACLES TO INDEPENDENT LEARNING

In spite of the teacher's best efforts, many, if not most, classroom settings are organized in such a way that students are involved in schedules and organizational plans that foster dependence rather than the independence we prefer. Students are told what is to be learned, how long it will take them to learn it, the resources are defined by the teacher and, afterwards, the teacher rather than the student decides whether the learning experience was a satisfactory and valuable one.

A LEARNING ATMOSPHERE

Each time we, as educators, focus on what our objectives are, we need to take a fresh look at our classroom mode of operation and evaluate the effectiveness of the way we teach. Quite naturally, for most of us, our teaching style has more to do with how we were taught than with what recent research has shown about the learning process. Even our good instincts have been overcome by the years of conditioning we have known in our own educational experiences.

• • •

Like a breath of fresh air, the recent findings coming from the research on the brain and how it operates are supporting our intuitive knowledge. This research is showing that our brains are receptive to learning only under certain conditions. Our job is to translate that information into a classroom atmosphere that provides:

- challenge
- freedom within structure
- trust and warmth
- opportunities to experience success
- personal involvement in the curricula

A natural transition generally occurs that transforms the former "teacher-lecturer" into a "fellow-learner". As a "fellow-learner" the teacher's role becomes one of a resource person, a facilitator and a classroom manager. In this maturing atmosphere, students gradually come to see themselves as responsible for their own learning and a foundation for self-direction is set.

• • •

At this point, a sometimes unexpected problem arises. We find the student no more ready for their independent learning than we, as teachers, were ready to allow it. This common occurrence is mentioned repeatedly in the literature dealing with programming for the gifted, an area where independent study and research are recommended as a major curricular activity (see **Suggested Reading List:** Maker (1982), Doherty & Evans (1980), and Feldhusen and Treffinger (1980).

FROM PASSIVE LEARNER TO ACTIVE PARTICIPANT (BRIDGING THE GAP)

The **ZEPHYR** self-directed study unit was developed expressly to bridge that gap . . . to transport the student from the position of passive recipient to that of an active participant in his/her own pursuit of knowledge.

Within the defined structure of each unit, the students are given opportunities to:

- make choices
- learn at their own pace
- learn in a manner more closely suited to their own learning style
- expand research skills
- use a variety of modalities
- plan their own time
- develop the skills of creative, critical and evaluative thinking
- experience whole-brain learning

Since responsibility for directing their own learning is so often an unfamiliar situation, the students will need your encouragement at the start. Generally, within six to nine weeks, most students will be well on their way from teacher dependence to self-motivation. (Beginning the venture with only a few choices, then gradually arranging the setting so that there are more and more choices, works best.) As students assume more responsibility, many teachers begin to consider the school library as just another part of the classroom . . . the benefits are many . . . from gaining a personal relationship with the librarian to learning about the enormous resources available, but often unused, in most school libraries.

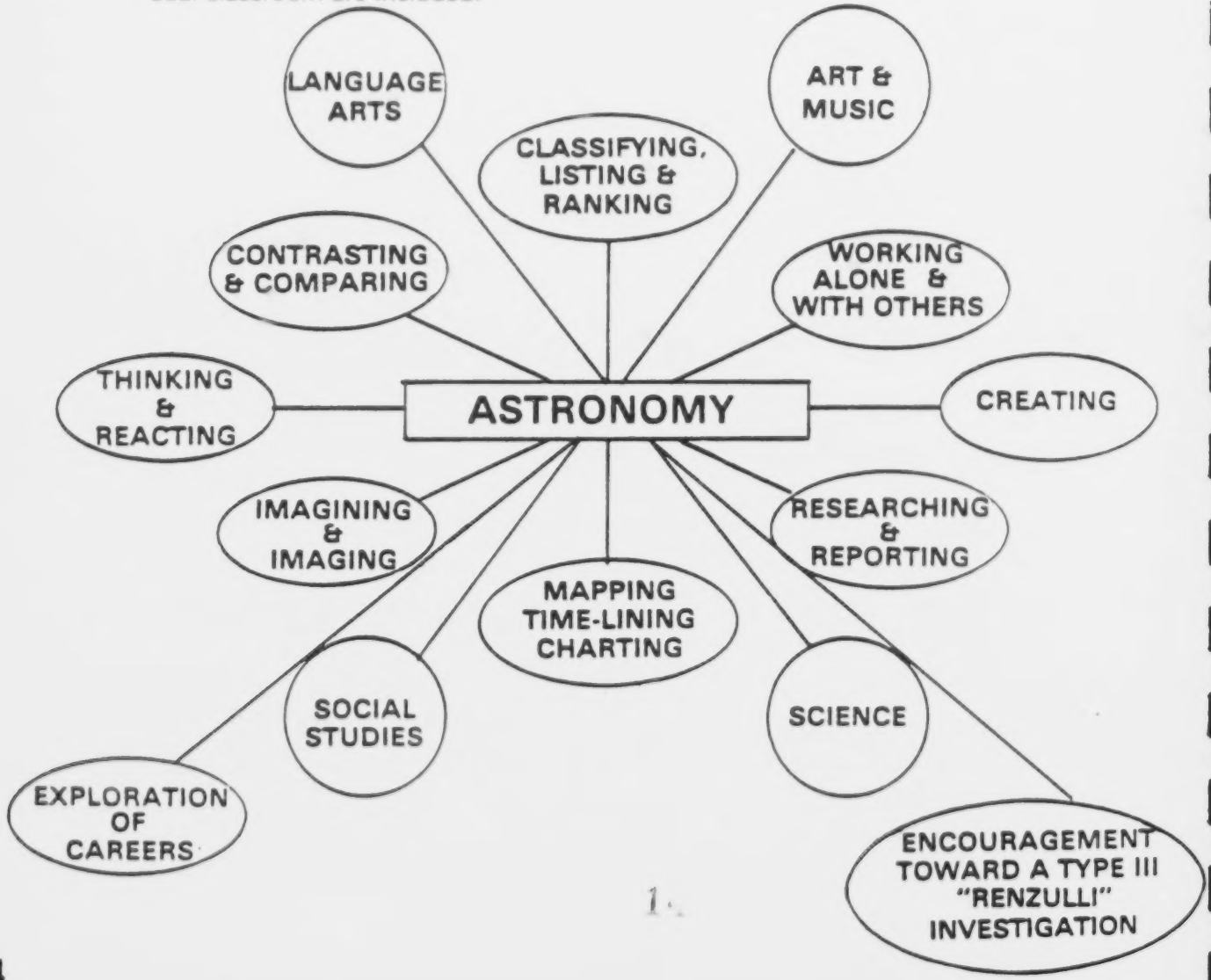
Eventually, a few students will be ready for a true investigative research study of professional quality as suggested by Joseph Renzulli in **The Enrichment Triad Model, A Guide for Developing Programs for the Gifted and Talented**, 1977.

THE FORMAT

Originally developed for the gifted student, these units emphasize the use of the higher level thinking skills . . . and are appropriate for use in any classroom where the goal is to encourage students to become responsible for their own education.

Interdisciplinary in content, the unit envelopes a broad view of the topic by integrating the "basics" into each activity.

Within this book are two complete units, one created for the upper elementary gifted student and the other for the lower elementary gifted student. Suggestions for adaptations for adjusting either of the levels to fit any individual classroom are included.



SUGGESTED READINGS

SELF-DIRECTED STUDY

"Bells, Groups and Independent Study", **Psychology and Education of the Gifted.** Barbe, W. and Renzulli, J. New York, 1975. Irvington Publishers.

Creative Questioning and Sensitive Listening Techniques. Carin, A. and Sund, R. Columbus, Ohio, 1978. Charles Merrill Publishing Company.

Creative Thinking and Problem Solving in Gifted Education. Feldhusen and Treffinger. Dubuque, Iowa, 1980. Kendall-Hunt Publishing.

Curriculum Development for the Gifted. Maker, C.J. Rockville, Maryland, 1982. Aspen Systems Corporation.

Enrichment Triad Model: A Guide for Developing Defensible Programs for the Gifted and Talented. Renzulli, J. Mansfield, Connecticut, 1977. Creative Learning Press.

Growing Up Gifted. Clark, B. Columbus, Ohio, 1978. Charles Merrill Publishing Company.

Open to Change: Options for Teaching Self-Directed Learners. Malehorn, H. Palo Alto, California, 1978. Scott Foresman Company.

Self Concept and School Achievement. Purkey. Englewood Cliffs, N.J., 1970. Prentice-Hall, Inc.

Self Starter Kit for Independent Learning. Doherty and Evans. Austin, Texas, 1980. Special Education Associates.

Teaching the Gifted Child. Gallagher, J. Boston, Massachusetts, 1975. Allyn and Bacon

INTEREST DEVELOPMENT CENTER

ASTRONOMY

THE PURPOSE OF THE INTEREST DEVELOPMENT CENTER IS TO STIMULATE INTEREST IN THE TOPIC AREA. THE STUDENT NEEDS TIME FOR BROWSING AND INVESTIGATION FOR MAXIMUM BENEFIT.

(Beginning ideas . . . . . you and your students will think of more . . . . . let parents and other teachers know about the Center and it will many times grow without effort.)

BOOKS AND POSTERS:

- **STARS, METEORS, PLANETS, ASTEROIDS**
- **CONSTELLATIONS**
- **SPACE**
- **GREEK AND ROMAN MYTHOLOGY**
- **VIKINGS**
- **NAVAJO CREATION MYTHS**
- **ASTROLOGY**
- **ASTRO-ARCHAEOLOGY**
- **TELESCOPES**
- **HOW-TO-BUILD-BOOKS ON TELESCOPES AND SUNDIALS**
- **SPACE EXPLORATION**

MAPS AND GLOBES
TELESCOPES
FARMER'S ALMANAC
DOCUMENTS
FILMSTRIPS, LOOPS AND SLIDES
SKY LOGS
STAR ATLAS
MAGAZINES
POSTERS
SPACE ART
NEWS ARTICLES

TIN CAN, PAPER, NAILS in a variety of sizes and a **FLASHLIGHT** (students can create simulated constellations)

I HEAR ..... AND I FORGET
I SEE ..... AND I REMEMBER
I DO ..... AND I UNDERSTAND
(source unknown)

GETTING STARTED

1. **Select a topic** as an extension of a regular curricular subject (particularly when your class seems to crave more) . . . or . . . select a topic to pursue that is of particular interest and may not be part of the curricula. To **zero in on special interests**, administer an interest survey to each student.

2. **Copy the unit for each student.** When using these units for the entire class you may want to expand or delete activities for individual students.

3. **Set up a center** in the classroom **that encourages exploration** in the subject field. You'll want to in-include a wide variety of materials. **Be creative**, the purpose of the center is to **excite the student in this subject area** so begin with **lots of "hands on" materials . . . . allow for ample browsing time** and **encourage the student to investigate** and become absorbed . . . . **at the level of a true professional.**

4. With the students, **go over each activity** in the unit, discussing and answering any questions. The **teacher is an integral key** in successful implementation. Because most children are already well-versed in the **"One Right Answer Game"**, they will need encouragement to branch out into many of the open-ended activities in the packets.

5. **Set the stage** . . . plan to **conference as needed** . . . . **provide resources as needed** . . . . then **get out of the way** and let your students learn.

6. **Give as much time** as each student needs to complete each activity in the unit. The entire packet might take from five to ten weeks or longer.

7. As each activity is completed and evaluated, **initial the symbol** located near each activity number. You will want to **evaluate** on the basis of what response is appropriate for **that student**.

8. When a student shows an extreme interest in the topic, the completion of this unit might be only the beginning. This student may well be ready for further study and research and **needs** only the **resources, guidance and freedom** to pursue his/her well-planned project.

In preparation for further research, the student will need to decide:

WHAT WILL THE STUDY BE? (what will be investigated and produced)

WHERE WILL BACKGROUND INFORMATION BE FOUND? (i.e., speakers, interviews, books, films, microfiche, documents, etc.)

WHAT, EXACTLY, WILL BE THE FORM OF THE PRODUCT? (a model, a manuscript, or . . .)

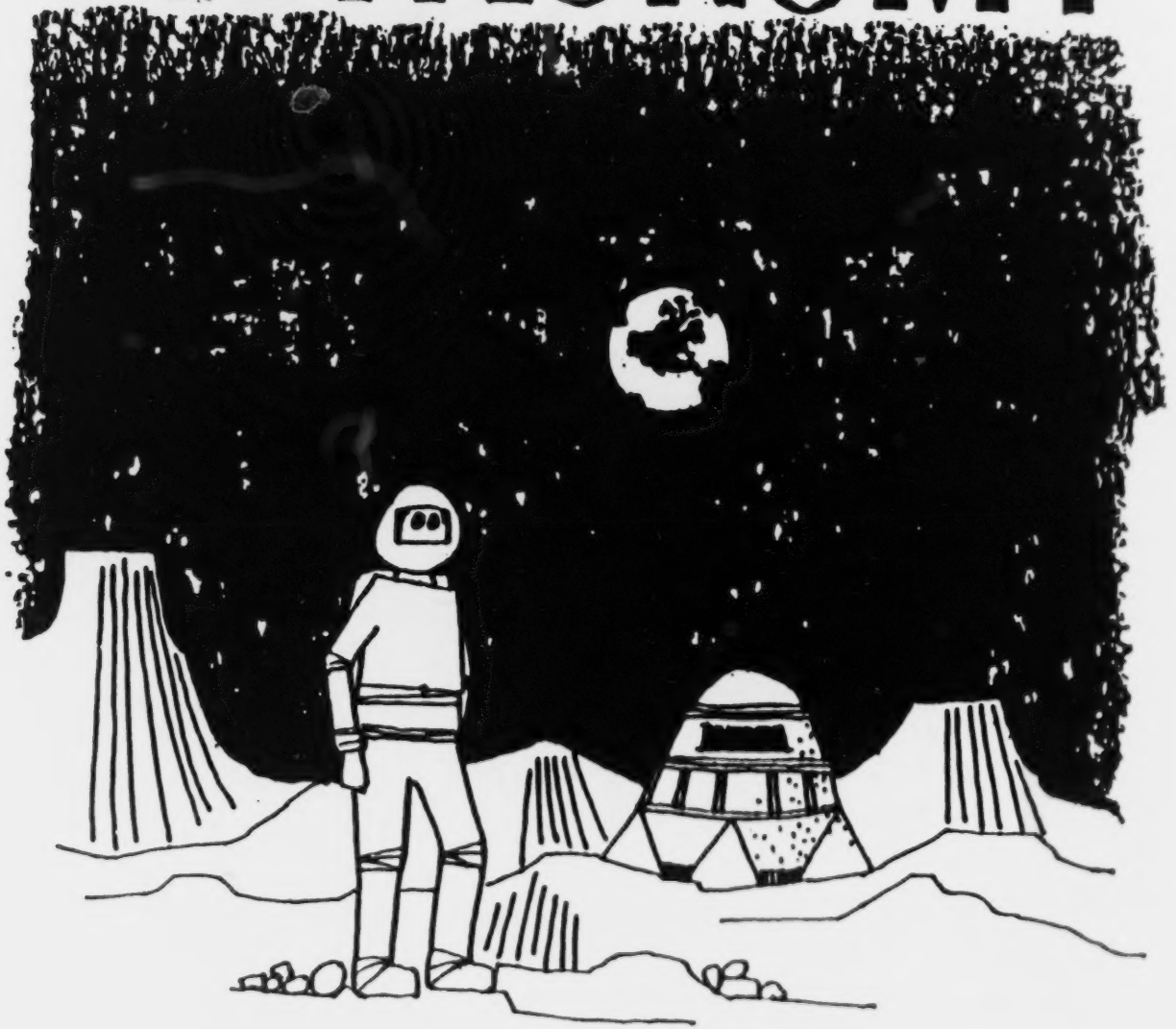
WHO MIGHT BE INTERESTED IN THE PRODUCT? (professionals in the field, publishers, organizations, etc.)

WHAT IS NEEDED TO BEGIN? (specific plans, resources, deadlines . .)

AGAIN . . . STEP BACK . . . PROVIDE GUIDANCE . . .
and LET HIM/HER GO!

ASTRONOMY

Unit I



NAME _____

DATE _____

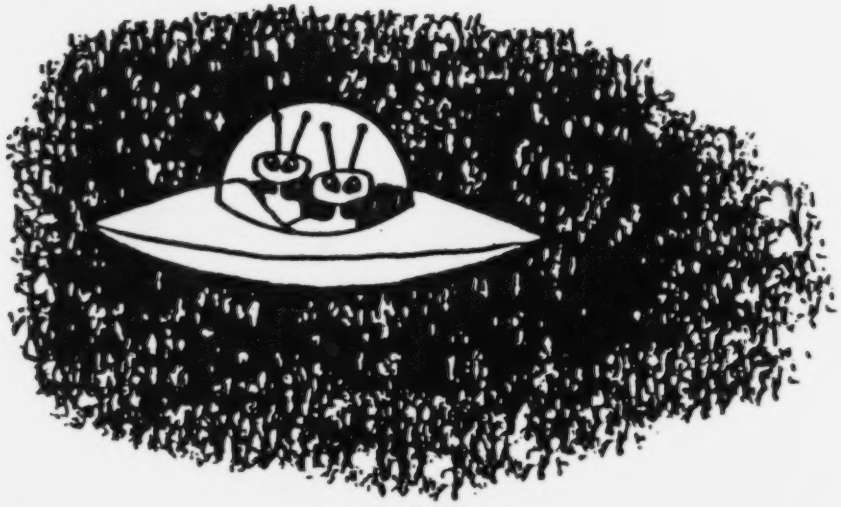
The following pages are to be reproduced for use in your classroom. You may want to copy directly from this book or cut the pages out first . . . then keep them in a folder to use another year.

1. SETTING THE STAGE....

Find some books about the Universe, the Earth and our Solar System.

Then find some books about people long ago who studied these wonders.

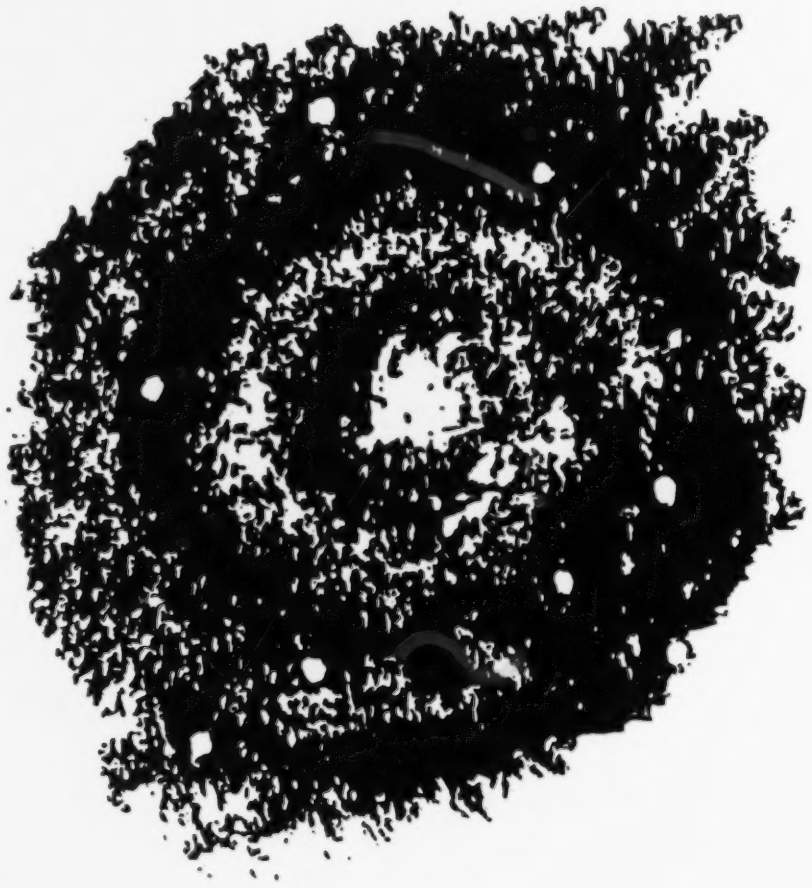
Take time to enjoy these books.



Think of at least 3 amazing facts or ideas about our Universe.

2. RESEARCH and REPORT

Find out all you can about the Milky Way. Make a mural showing it. Mark any important stars or planets.



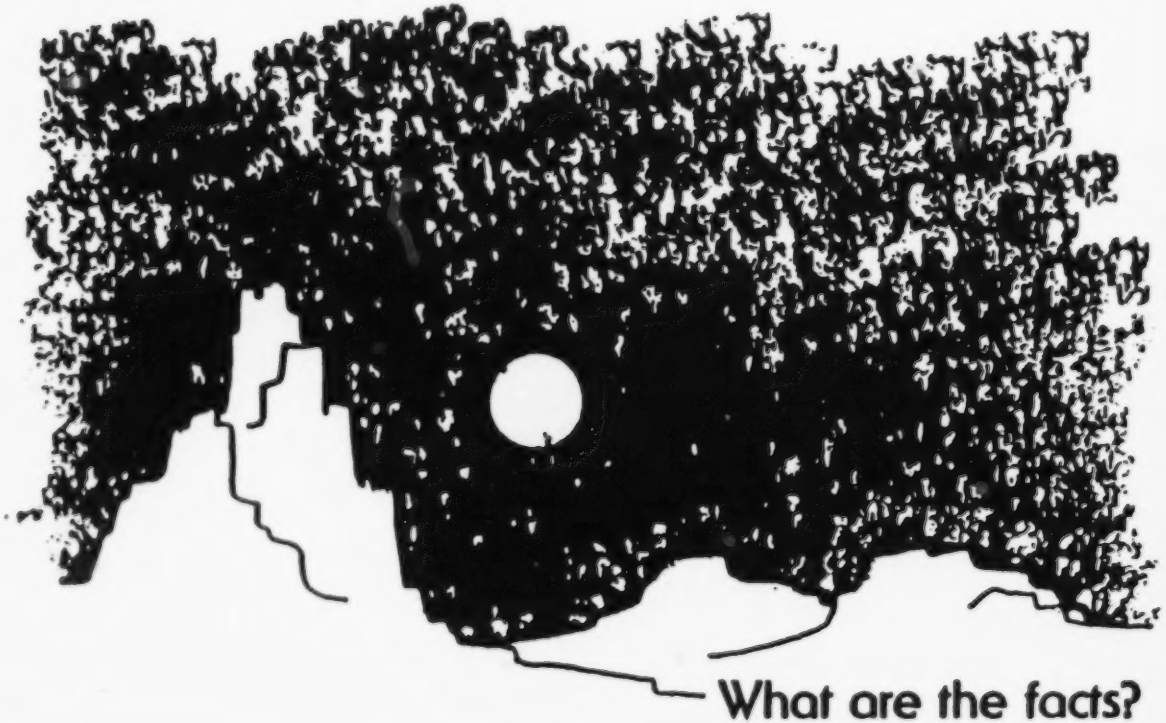
OR

Make a chart or mural of your favorite constellation.

3. WITH *OTHERS*

What would happen if our moon fell off into space?

Ask 5 friends what they think.



What are the facts?

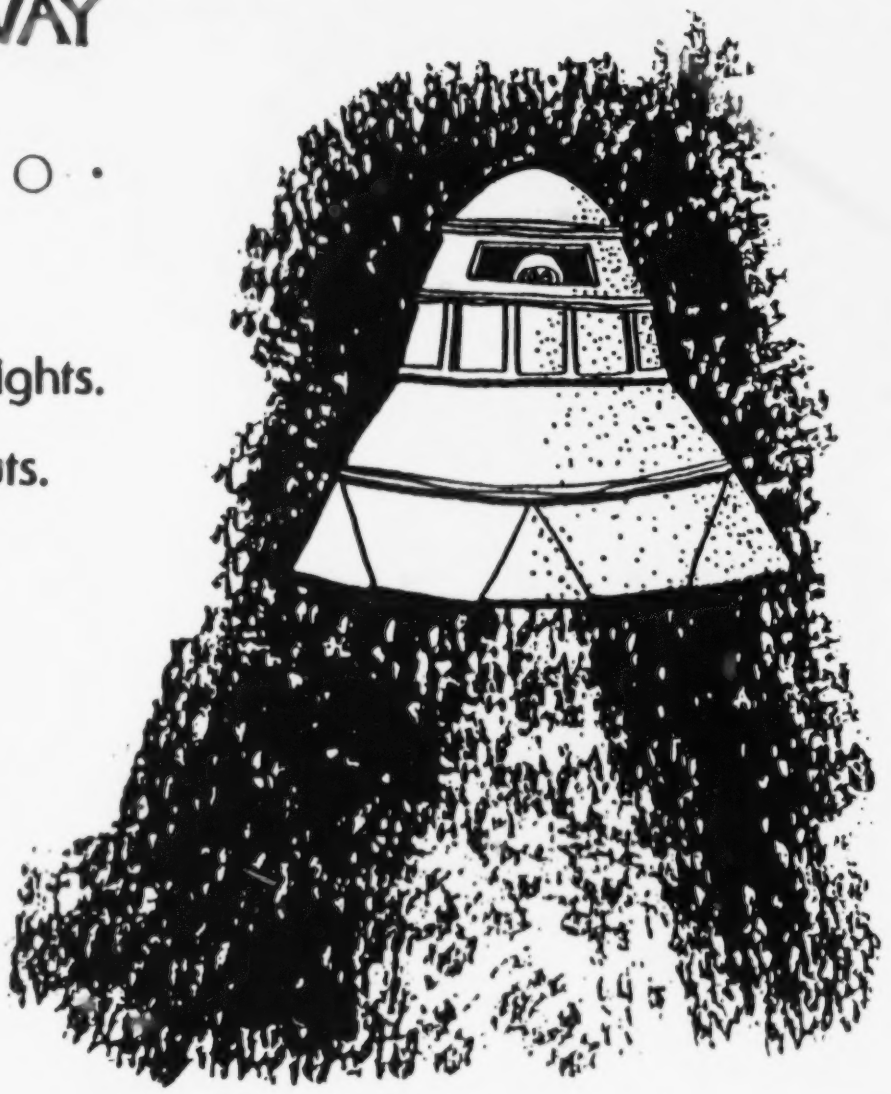
4. LEADING THE WAY

Study about some of the space flights.

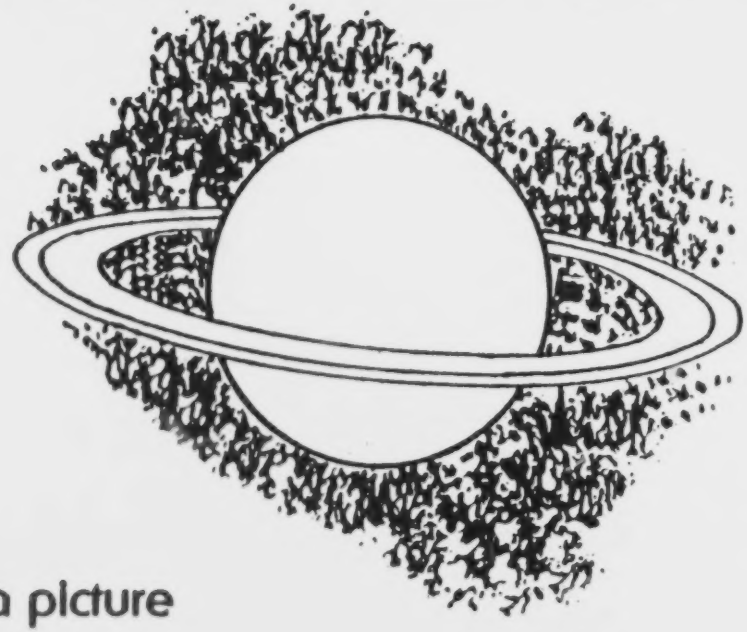
Make a scrapbook about astronauts.

OR

Pretend you are an astronaut. Describe your flight to your class. Be accurate.



5. FIND OUT



Find out about Saturn and it's rings. Draw a picture and label it.

OR

Study a globe and find out about longitude and latitude. Draw a picture and label the longitude and latitude of where you live.

Explain your findings to your class.

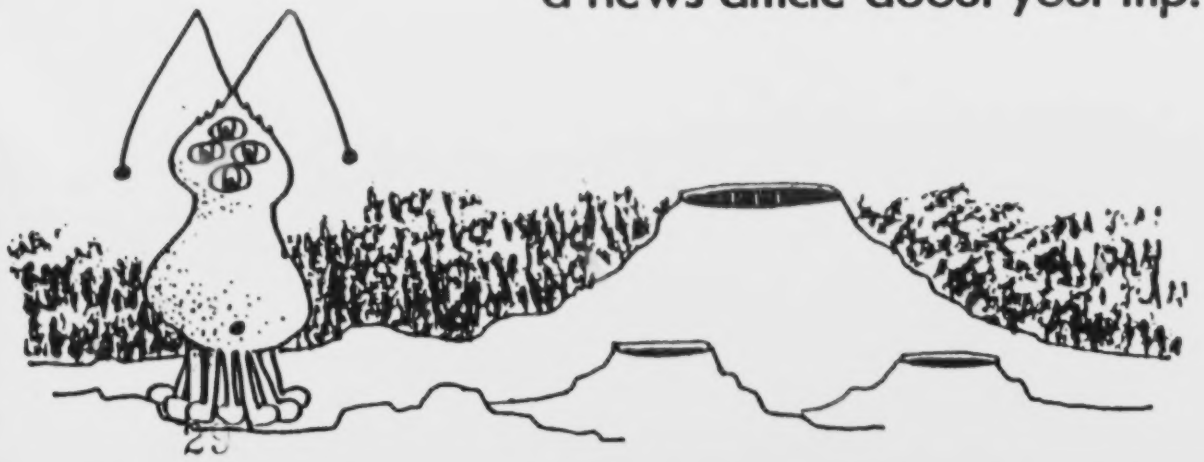
6. INVESTIGATE • CREATE

Find out about Black Holes. Imagine what you think is in the center. Write a story, poem or song about Black Holes.

OR

Find out about the Big Dipper.

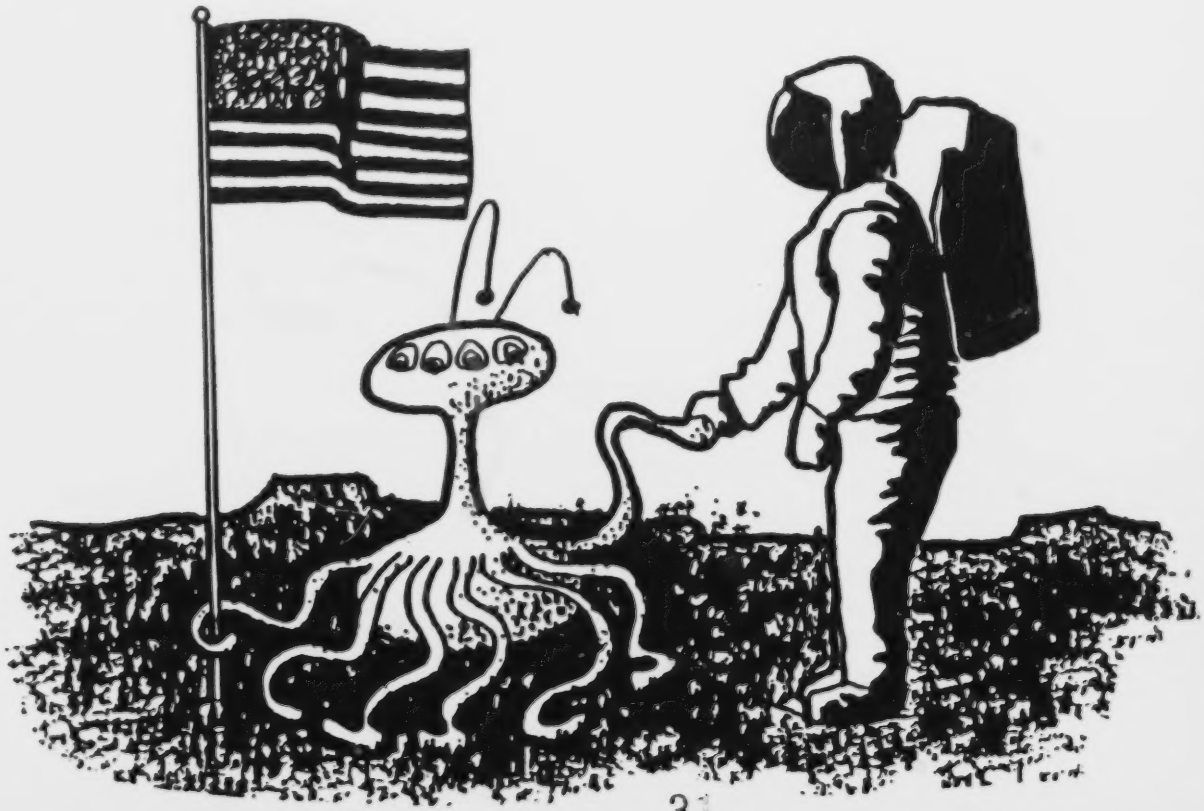
Imagine that you take a trip to the Big Dipper. Write a news article about your trip.



7. GETTING ACQUAINTED *with* PEOPLE IN SPACE CAREERS

Invite a man or woman to talk to your class about careers in Space Research.

Plan 5 questions to ask.



8. ART~CRAFT~BUILDING

With clay, papier mache, or odds and ends build:

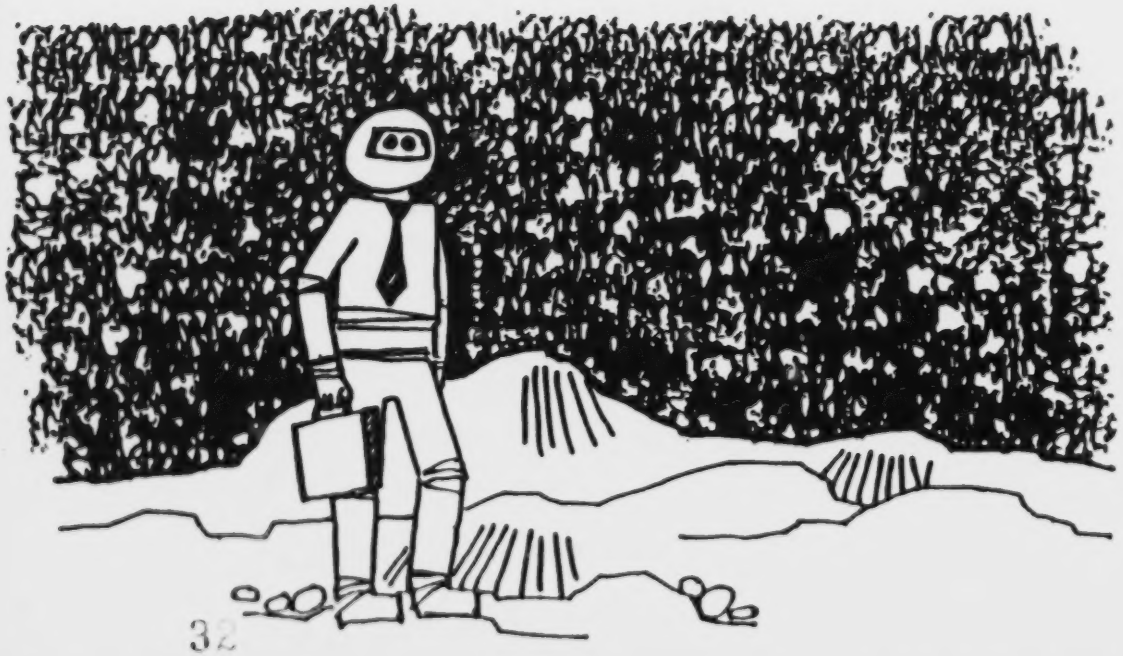
A sundial that works

OR

A model of a rocket OR A mobile of our solar system

OR

A machine for moon travel.



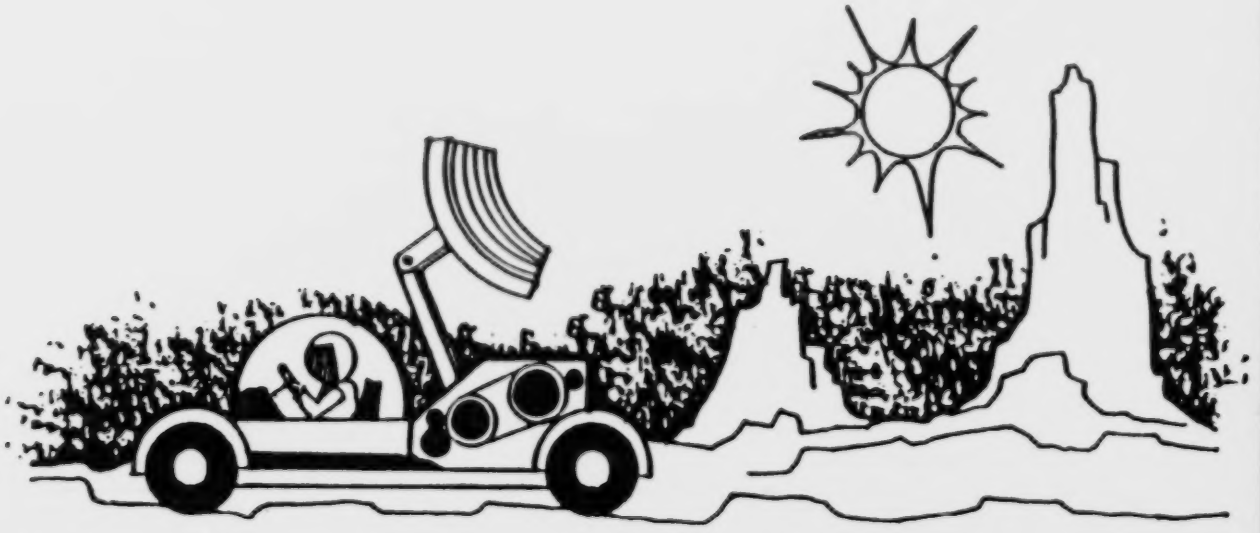
Display your creation with a description.

9. USING YOUR "STAR-STUDDED" CREATIVITY

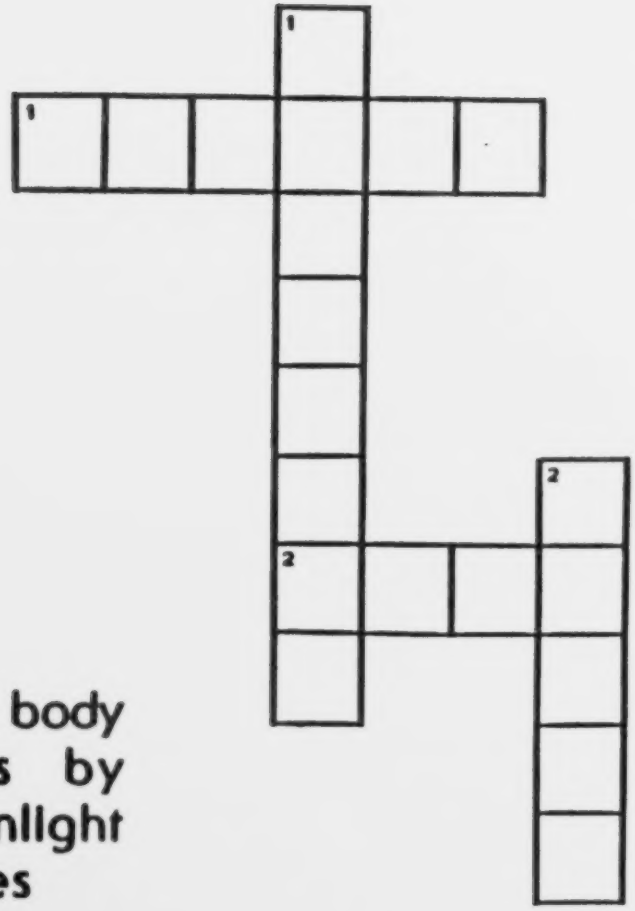
Organize some materials about astronomy so your class can learn. Arrange it in a special place.

Books	Pictures
Magazines	Tapes of space music
Filmstrips	(Think of more ideas.)

Make an announcement to your class about your Astronomy Center. Invite them in!



10. A NEW LANGUAGE



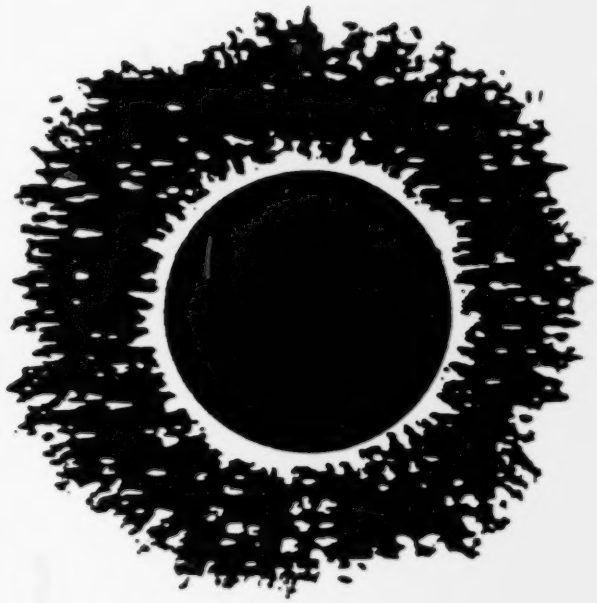
DOWN

1. The cosmos
2. The path of a heavenly body

ACROSS

1. A heavenly body that shines by reflected sunlight and revolves around the sun.
2. a self-luminous heavenly body.

A NEW LANGUAGE



KEY

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DOWN

1. The cosmos
2. The path of a heavenly body

ACROSS

1. A heavenly body that shines by reflected sunlight and revolves around the sun.
2. a self-luminous heavenly body.

SUGGESTIONS FOR ADAPTING THE UNIT TO YOUR PARTICULAR TEACHING-LEARNING SITUATION

1. Require fewer, or more, research sources.

2. Assign more of the activities to small groups instead of to individual students.

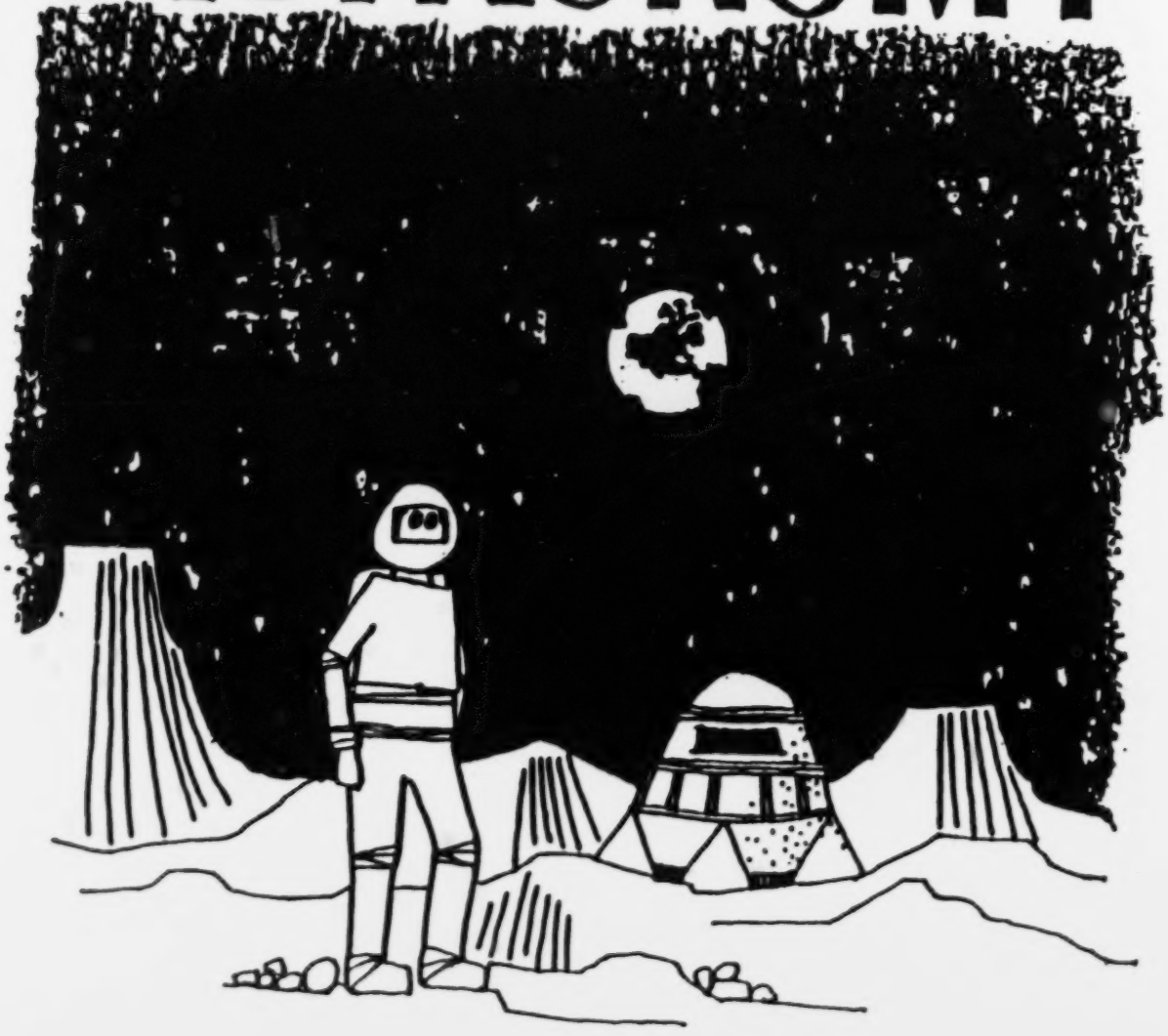
3. Give fewer or more choices.

4. Delete some activities altogether.

5. Arrange the unit to be a class project with students choosing different parts to complete.

6. Add some activities of your own.

ASTRONOMY



Unit II

NAME _____

DATE _____

The following pages are to be reproduced for use in your classroom. You may want to copy directly from this book or cut the pages out first . . . then keep them in a folder to use another year.

1. SETTING THE STAGE....

"...It is a bad (though well rewarded) habit of some academics to teach their own subject as if it had nothing to do with others. It is precisely by seeing the connections between the fields however, that one becomes educated."

Gerald Holton in PHYSICS TODAY
November 1970

What fields can be connected to astronomy? Think of at least 15... then add some more!

Throughout the ages man has speculated about the Universe, the Earth, and our Solar System. For beginnings, find out some thoughts of Ptolemy, Copernicus, Kepler, and Herschel.

"No man I know of has gone to the moon that has not been affected in some way that is similar. It is what I prefer to call instant global consciousness. Each man comes back with a feeling that he is no longer only an American citizen; he is a planetary citizen. He doesn't like things the way they are, and he wants to improve them...."

– Edgar Mitchell
Apollo 14 Astronaut

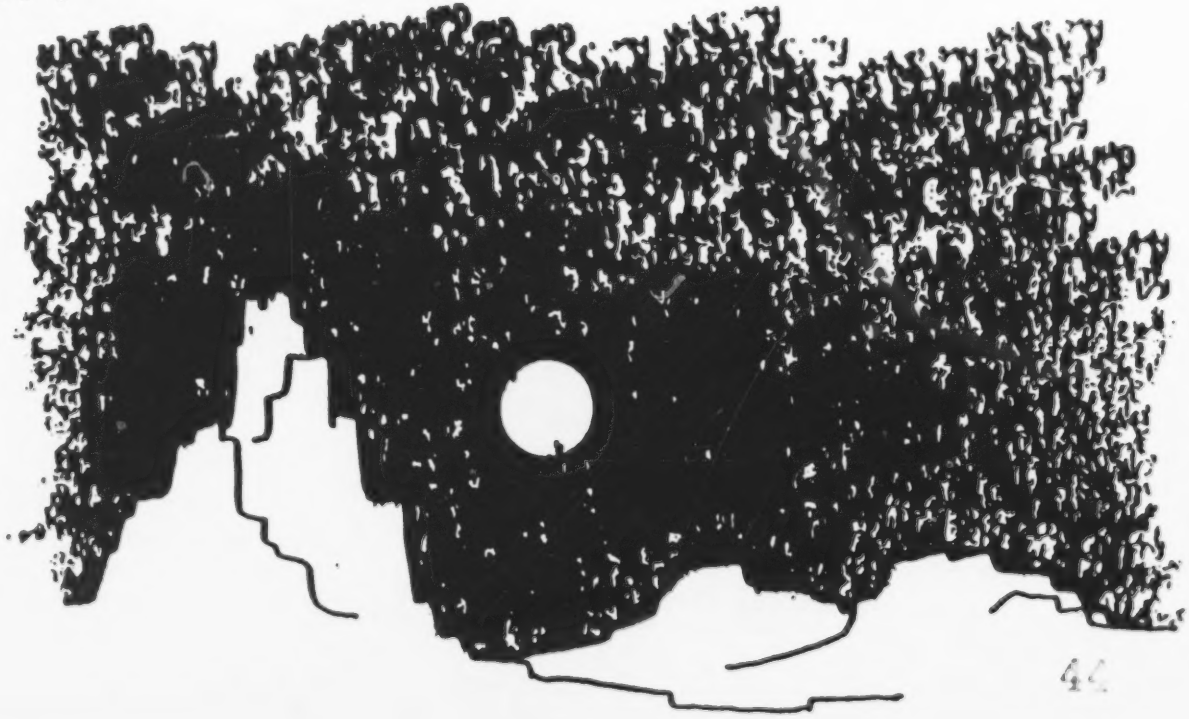
Collect at least 5 quotes by astronauts who have visited outer space. Based on these quotes, comment on the statement of Edgar Mitchell.

2. WITH OTHERS (choose one)

What would happen if our moon fell off into space? Interview at least 10 friends and record their opinions. What does research say? Present your findings in a filmstrip or another way of your choice.

Organize a class debate: "Which planet could be colonized in the year 2000?".

Compare your weight on Earth with your weight on the Moon, on Mars, or on Saturn. Chart at least ten persons.



3. RESEARCH and REPORT *choose one:*

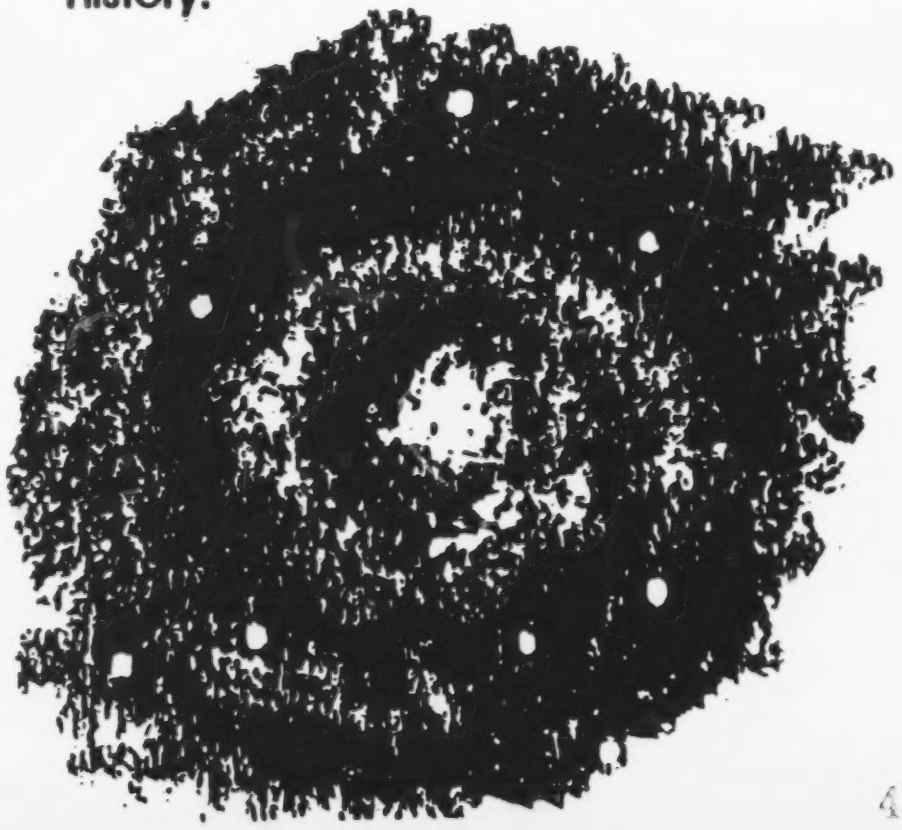
RESEARCH the known satellites in our solar system.

COLLECT data about stars... the nearest star... the "Big 4" constellations. Locate them in the sky at night.

RESEARCH at least two of the "Founding Fathers of Space Flight".

FIND OUT all you can about our galaxy, the Milky Way. Is it like other galaxies that have been found in the universe?

FIND OUT about the development of calendars throughout history.



Report your findings by

- ☐ writing a magazine article
- ☐ a dramatization
- ☐ reporting to your class
- ☐ _____

(your idea)

4. LEADING THE WAY

Connect each person to his contribution to astronomy:

Bessel	German astronomer first measured parallax of a star
Galileo	Measured the size of the Earth without leaving Alexandria
Eratosthenes	Discovered phases of Venus and four moons of Jupiter
Kepler	Author of Almagest, chief authority among astronomers for over 1400 years
Tycho Brahe	Published mathematical derivation of Kepler's laws, noted as author of theory of universal gravitation
Einstein	Developed theory of relativity
Newton	Established three laws of planetary motion
Ptolemy	Displaced earth-centered theory with sun as center of universe.
Copernicus	Reformed astronomy into a more exact science, joined by Kepler in 1600.

5. MAPPING...TIME LINES...and ....(BY YOURSELF OR WITH OTHERS)

choose one:

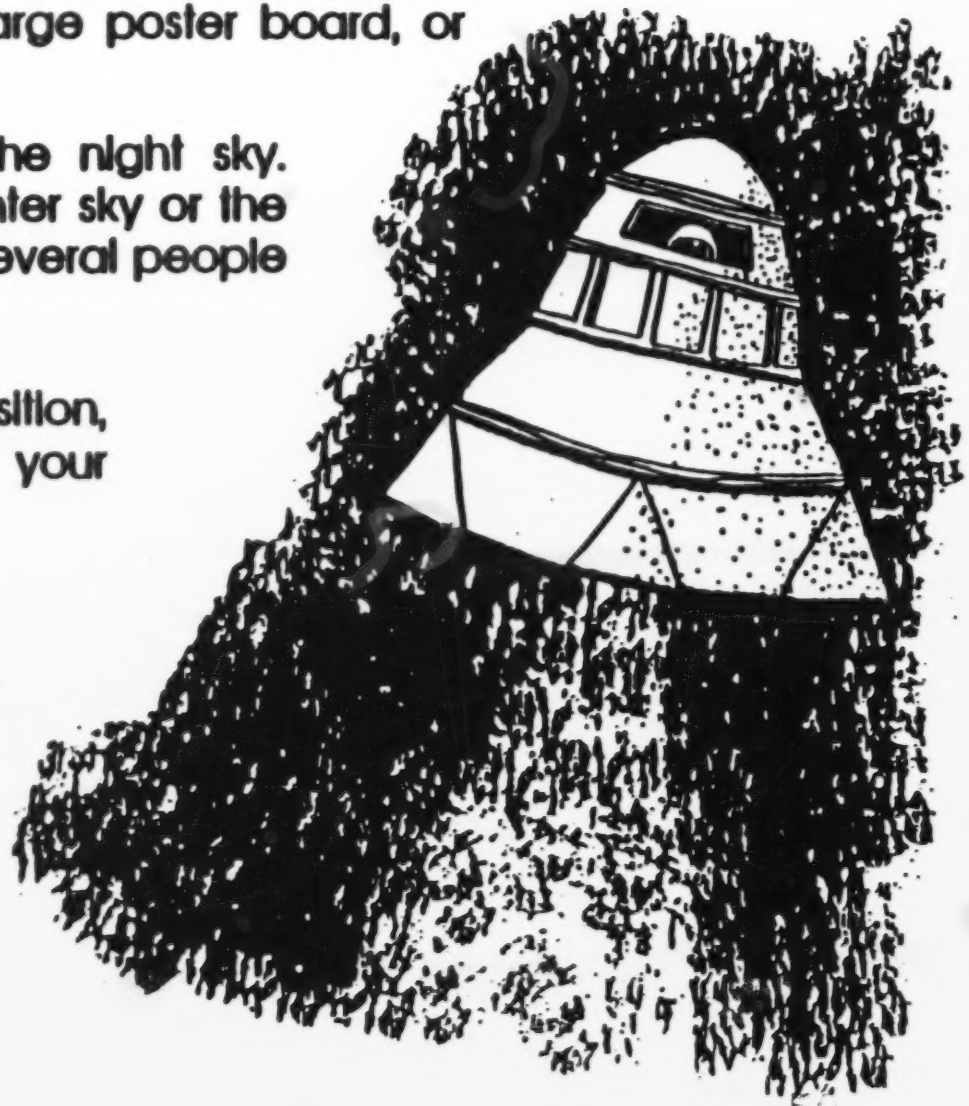
Map our galaxy and place our Sun in it. Make a scale drawing of the orbit of the planets on a large poster board, or a mobile.

Create a classroom planetarium of the night sky. Choose the display to be either the winter sky or the summer sky. Make it large enough for several people to sit inside.

Study the orbit of asteroids, their composition, and how they came to exist. Present your findings. (be creative)

Study the manned space flights to this date. Prepare a questionnaire to find out what is remembered about each one. Publish the results.

Make a time line showing the improvements of the telescope and the discoveries of planetary bodies during that same time span.



6. INVESTIGATE · CREATE

Research the planets in our solar system. Prepare a scrap book on astronomy. Design a "Three Planet Tour to Pluto" with some of your friends.

OR

Research Black Holes. Imagine what you think might be in the center of these phenomena? Write an imaginary story, poem or song about them.

OR

Temperature is an important property of our environment. Man has developed 3 types of measurement. Find out about them and create an experiment to show the differences.

OR

Find out about several theories of the Earth's formation. Have scientists found planets orbiting any other stars?

(See the November-December issue of MERCURY in a reference to the song "Spiral Galaxy 28948")

Write a news article reporting your findings.

OR

Open a window into space and look for other galaxies. Is there human life out there somewhere? Tape record a story using both real and fictional ideas. (Include background effects.)

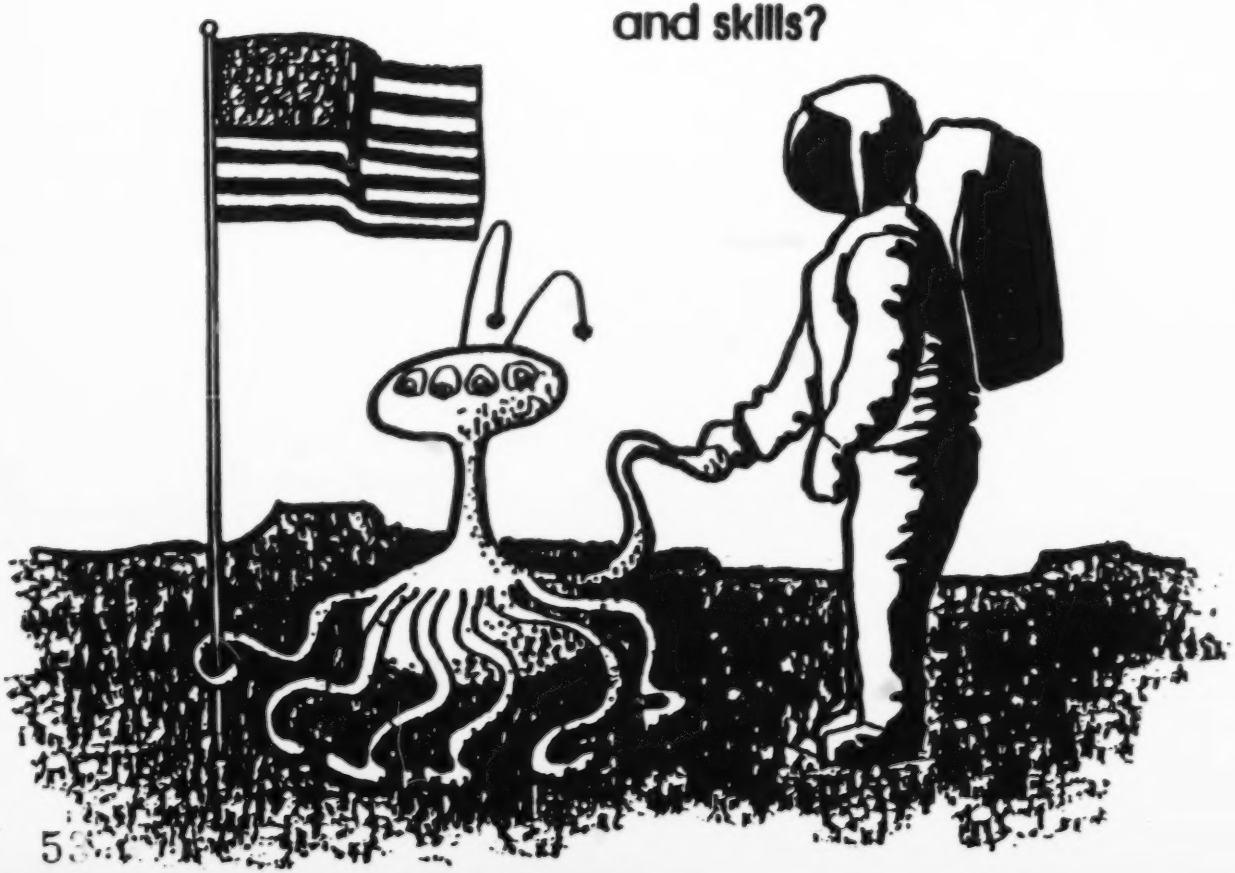
7. GETTING ACQUAINTED *with* PEOPLE IN SPACE CAREERS

FIND OUT about the lives of women who have been pioneers in Space Research.

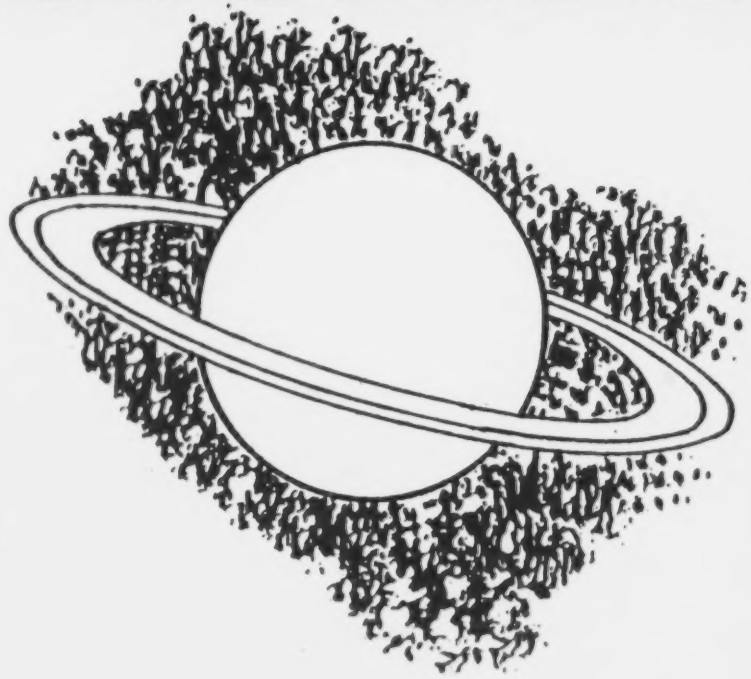
OR

INVESTIGATE the lives of some of the astronauts.

What similarities and differences can you find in their childhoods, interests and skills?



8. FIND OUT
(AS MANY AS YOU CAN)



How the Greek scientist Eratosthenes measured the size of the earth.

The most recent discoveries related to Saturn and its rings.

How long it would take a space ship to travel to the Sun.

If the wind blows in space.

What happens inside a space ship going as fast as the speed of light.

When the sunlight you see today is actually emitted from the sun.

How fusion works in a rocket.

About John Milton's description of our solar system in "Paradise Lost".

9. USING YOUR "STAR-STUDDED" CREATIVITY

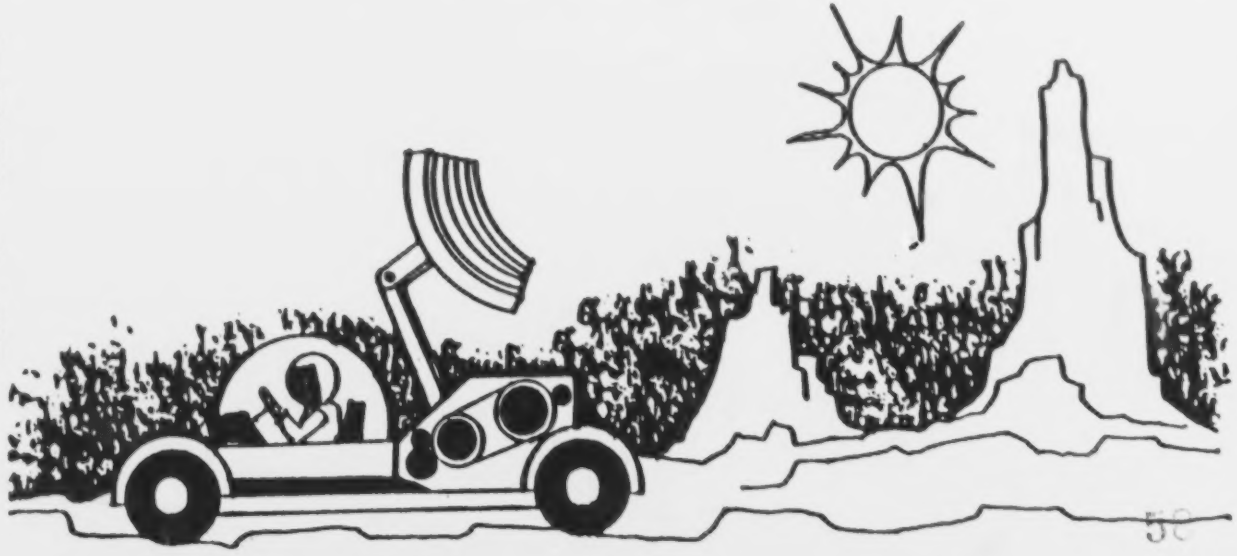
choose one or more

Create some astronomical bumper stickers like "Supernovae Are A Blast". (From the collection of the Astronomical Society of the Pacific.)

Create a game that would teach the participants about space.

Invent a solar vehicle for transportation on the moon. Build a scaled model of it and advertise it for sale.
(See Space Sciences, Western Space Congress 1970.) How does someone sell a product through advertising?

Organize a center in your classroom for creating "Space Art". Include tapes of space "music" (See November-December Issue of Mercury), and art materials. Exhibit the work.



10. TIME and SPACE

choose two

MEASURE the longitute and latitude of the location of your school and one other spot you know.

INVESTIGATE the different ways man has kept time. How is the International Date Line related to time?

ILLUSTRATE the yearly changes in the path of the Sun's rays. Draw the Sun's path across the Earth's sky in your city or town.
Compare: June 21
December 21
March 21

WHAT is the difference between gravity and magnetism? Prepare a concrete experiment to show these differences.

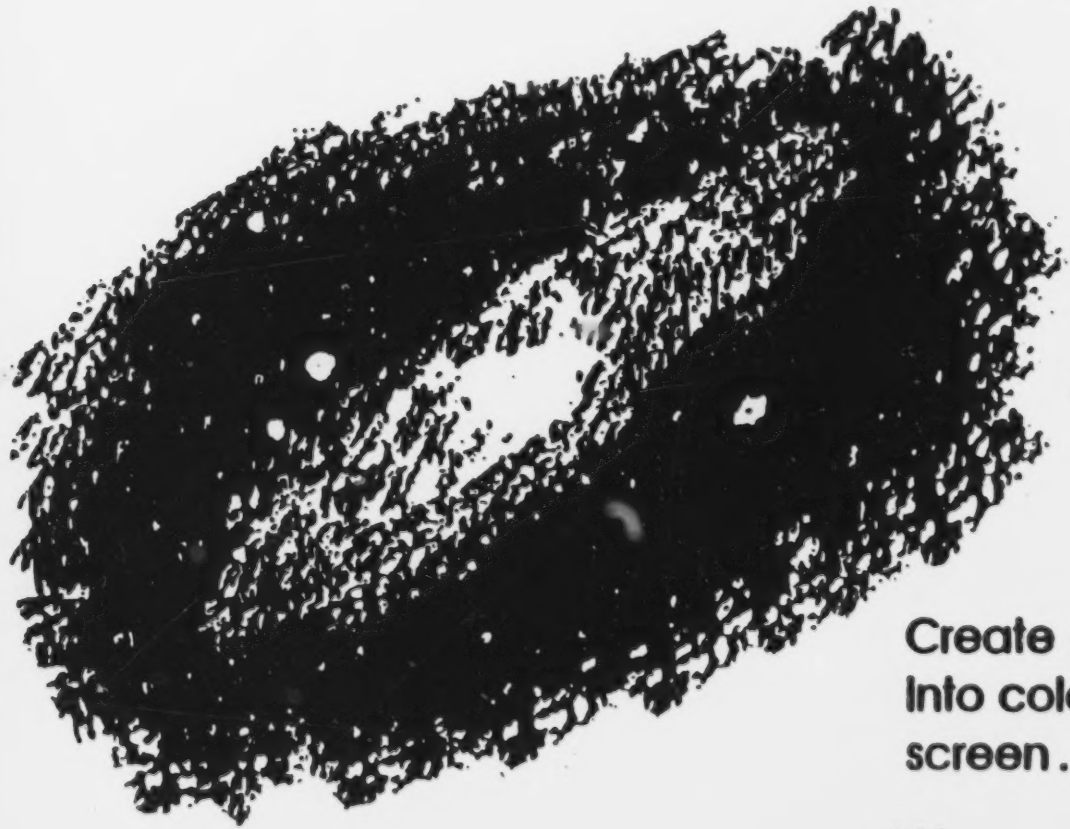
MEASURE the Big Dipper using angles and a protractor.

HOW wide is a time zone? Use a plastic dome and show the time zones of the Earth. Make up a questionnaire asking "What time is it in _____ if it's _____ in _____?"

Organize an exhibit showing your findings, the resources you used and other related artifacts. Display it in the library (or classroom).

11. ART~CRAFT~BUILDING

Locate some "HOW-TO" books and:



Build a refractor or reflector telescope. Try it out at night.

OR

Build a sundial that works.

OR

Build a rocket using balloons.

OR

Build a mobile of our solar system.

OR

Create a constellation show: prick holes into color slides, project the slides onto a screen . . . add music for effect.

OR

Take photographs of the night sky using black and white film. Create a bulletin board display of your pictures.

12. COMPARE and CONTRAST

CONTRAST the center of the Earth with the center of Saturn.

...OR...

CONTRAST & COMPARE two popular types of telescopes.

...OR...

COMPARE the "Terrestrial" planets and the "Giant" planets in our solar system.

...OR...

CONTRAST & COMPARE a Solar and Lunar eclipse.

...OR...

NOTE the similarities and differences of the moons in our solar system.

13. SPACE PUZZLES☆

1. What is a light year? Find out how fast this is per minute, per hour, per day, per year, per second in miles per hour, kilometer per hour, etc.

2. If two rocketships take off at the same moment, one from the moon traveling at 18,000 miles per hour and the other takes off from the Earth traveling at 24,000 miles per hour... How far apart are the two rocketships one minute before they pass each other?

3. What do you know about tides? A large yacht has a 12-foot rope ladder hanging over the side... the rungs are one foot apart. The bottom rung is touching the water. The tide is rising at a rate of 6 inches per hour. When will the first three rungs of the ladder be covered with water?

4. If a man can jump 6 times higher on the Moon than he can jump on the Earth, how far can an Olympic pole vaulter jump on the moon?

5. In a city in Nebraska, the Sun is about 4,000 miles nearer the Earth at noon than it is in the evening at sunset. Why is this true? Draw a diagram to prove your answer.

6. Inertia is a problem astronauts must deal with in space. What is inertia? Name two or three ways to empty a glass of water in space.

7. If you lost your oars from a rowboat and you had a rope, how could you get your boat to move to the shore? When you have solved this puzzle, find out if the same principle applies on a space ship stranded in outer space.

☆ one of these is just for fun

14. CAREERS in SPACE

ORGANIZE a Careers In Space Week. Plan speakers, films, field trips, etc.

...OR...

DRAMATIZE a "TV Interview" with the following persons:

Dr. Konstantin Tsiolkowski

Dr. Hermann Oberth

Dr. Robert Goddar

Dr. Wernher Von Braun

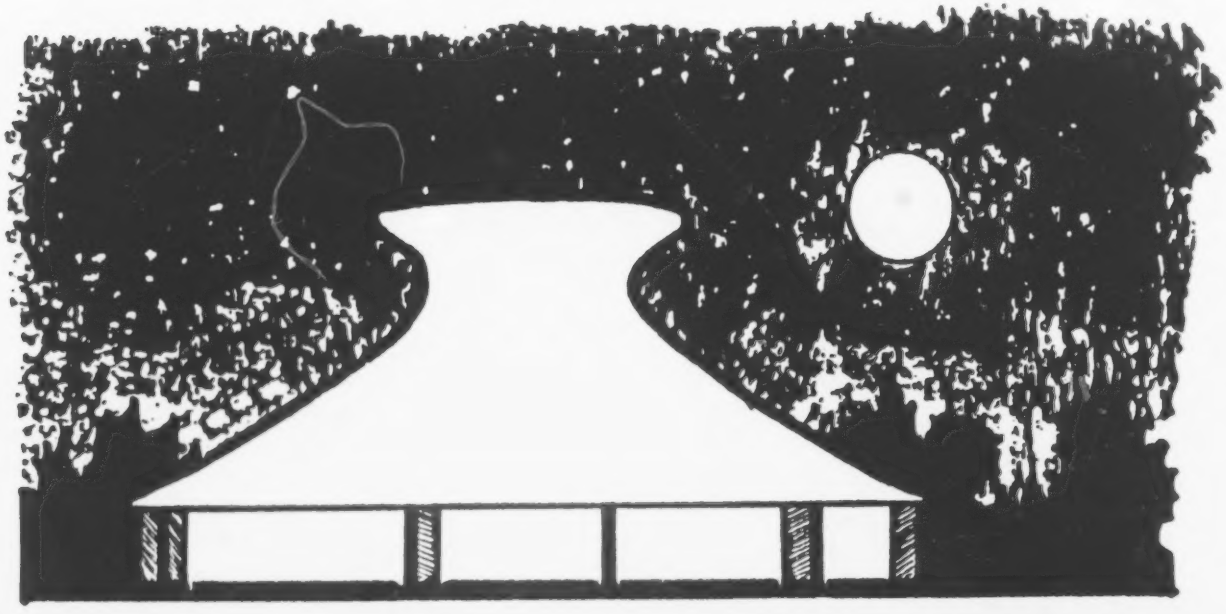
Dr. Eugene Sanger

Plan a minimum of eight questions for each person.

15. A NEW LANGUAGE

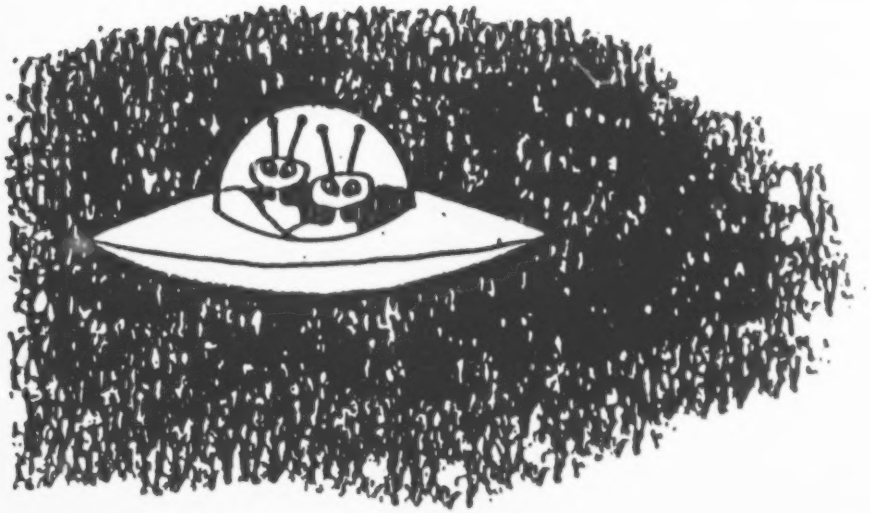
parallax
orbit
galaxy
sphere
planetarium
eclipse
quark
supernovae
Big Bang
Red Giant
Blue Straggler

interstellar matter
Kohoutek
pulsar
quasar
space shuttle
astro physical laboratory
terrestrial astronomer
cosmologist
cepheid
Crab Nebula
Great Andromida Spiral



16. LEARNING MORE....

You've had a glimpse of the world of astronomy . . . If you want more, consider study in some of these areas:



Astronomy and . . . . . .

Anthropology
Archaeology
Art
Energy (Solar Power)
Law (Interstellar Relations)
Light Pollution
Literature
Meteorology
Molecular Biology
Music
Philately (Stamps relating to astronomy)
Philosophy
Science Fiction
U.F.O.'s

Have Fun!

Interested in becoming a member of an amateur astronomy group?
See the May-June 1980 issue of MERCURY.

SPACE PUZZLES

KEY

1. 186,000 miles per second

   - x 60 for ___per minute
   - x 60 for ___per hour
   - x 60 for ___per day
   - x 60 for ___per year

   300,000 km. per second

   - x 60 for ___km per minutes
   - x 60 for ___km per hour
   - x 60 for ___km per day
   - x 60 for ___km per year

2. 700 miles apart one minute before passing.

3. Never, as the tide rises the yacht also rises and the water never rises higher than the first rung of the ladder.

4. A six foot bar heighth on the Earth would be 18½ feet on the moon. The heighth of the man and his center of gravity must be taken into consideration.

5. The sun is straight angle is closer to the Earth and is more at an angle at sunset. The sun is nearer to Earth by a distance equal to the radius of the earth at noon.

6. Hold the glass still and jerk it down from its base. The water will remain in place and the glass will be gone. or

   Swing the glass around and around in a circular motion. Centrifugal force will propel the water out of the glass.

7. Attach the rope to the back of the boat and jerk it back and forth causing the boat to rock. The friction causes a rocking motion which will cause the boat to slowly begin to move.

   In a Rocket ship in space there is no friction. The only way to move an object is by a thrust action such as gas propulsion.

ASTRONOMY
BIBLIOGRAPHY

Primary:

Adler, Irving and Ruth — THE CALENDAR
Describes the calendar development through the ages.

Asimov, Issac — ABC's OF SPACE

THE SUN

Benaick, Jeanne — THE BIG STRAWBERRY BOOK OF ASTRONOMY

Bergaust, Erik — THE RUSSIANS IN SPACE
Study of space exploration by the Russians.

Branley, Franklin M. — A BOOK OF THE MILKY WAY GALAXY FOR YOU
Writes about Galaxies and Nebulae.

THE END OF THE WORLD
Theories about the Sun ceasing to exist.

Colby, C.B. — MOON EXPLORATION

Crosby, Phoebe — STARS
Introduction to the constellations.

Fodor, R.V. — METEORITES
Theories and studies of known meteorites.

Ivins, Ann — STARS AND CONSTELLATIONS

Light, N.M. — STAR CIRCUS
Fictional story about performing in outer space.

Linn, Charles F. — PROBABILITY
Mathematical experiments.

Marsh, Susan — MAPS AND MAPMAKING
Introduction to measuring shadows, lunar maps and mapping planets.

Moche, Dianah — MARS
Introduction to the study of the planet Mars.

Ogden, Herbert and DeVault, M.Vere — ASTRONOMY
Contains facts about speed of light, telescopes and planets.

Polgreen, John and Cathleen — SUNLIGHT AND SHADOWS
Explores how measuring shadows can help to understand the Sun's rays.

Razzell, Arthur G. — PROBABILITY

Rutland, Jonathan — EXPLORING THE PLANETS

Schloat, G. Warren — ANDY'S WONDERFUL TELESCOPES
Contains a lot about refractor and reflector telescopes.

Shapp, Charles and Martha — LET'S FIND OUT ABOUT THE MOON

Intermediate: (4–8)

Ames, Gerald and Whyler, Rose	PLANET EARTH Explores spectroscopes, man made Sattelites, gravity and centrifical force.
Asimov, Isaac	GALAXIES
	BLACK HOLES
	HOW DID WE FIND OUT ABOUT COMETS
	OUTER SPACE
Baker, Wilfred	ELEMENTS OF PHOTOGRAMMETRY Explores studying astronomy with photography equipment.
Beiser, Arthur	THE EARTH Writes about living on the moon. Explores meteorites.
Bergaust, Eric	COLONIZING THE PLANETS Describes escape velocity, gravitational pull and rockets.
Bova, Ben	STARFLIGHT AND OTHER IMPROBABILITIES The knowns and the maybes of space science.
	THROUGH EYES OF WONDER A look at the interplay between science and science fiction.
Carlisle, Norman	SATTELITE SERVANTS OF MAN
Gallant, Roy	EXPLORING THE UNIVERSE Investigates rocket propullsion experiments, Astronaut careers and clothi to wear in outer space.
Gatland, Kenneth William	SPACEFLIGHT
Hill, Robert W.	MOON ASTRONAUTS Hypothesizes building underground cities on the Moon.
Kerrod, Robin	RACE FOR THE MOON History of man's exploration into Space.
Lewis, Claudia	POEMS OF EARTH AND SPACE
Nicolson, Iain	SIMPLE ASTRONOMY
Piper, Roger	THE BIG DISH Describes Radio Telescopes.
Richard, Kay	SPACE MAGIC WITH PHYSICS Experiments in physics.
Smith, Norman	MOONHOPPING Explores all the natural Sattelites of our Solar System.
Thurber, Walter	EXPLORING THE EARTH SCIENCE Investigates sundials, plotting the Sun's rays by measuring angles.
Unstead, R.J.	A SPACE STATION Good description of humans living in outer space.
Webster, David	PHOTO FUN Explores taking pictures at night of the night sky.
Wilkins, H. Percy and Moore, Patrick	HOW TO MAKE AND USE A TELESCOPE
Zarchy, Harry	WHEEL OF TIME Describes measuring by light years.

Adults:

Angrist, Stanley W.	BEYOND EARTH, THE SEARCH FOR EXTRATERRESTRIAL LIFE
Asimov, Isaac	ALPHA CENTAURI, THE NEAREST STAR
	ASIMOV ON ASTRONOMY
	THE COLLAPSING UNIVERSE
Bok, B.J.	FOCUS ON THE STARS Study of Constellations.
Bolton, Sarah K.	FAMOUS MEN OF SCIENCE Biographies
Branley, Franklin	THE END OF THE WORLD Hypothesizes how the Sun could cease to shine.
Dolin, Arnold	GREAT MEN OF SCIENCE
Ellis, R. H	KNOWING THE ATOMIC NUCLEUS
Fisher, David E.	THE CREATION OF ATOMS AND STARS
Gerendieu, Hart and Seeley	MAN DISCOVERS THE GALAXIES
Hoyt, Mary Finch	AMERICAN WOMEN OF THE SPACE AGE Biographies
Kittredge, Robert	SELF TAUGHT NAVIGATION Explores navigating through Space.
Kraske, Robert	IS THERE LIFE IN OUTER SPACE
Pickering, James	WINDOWS TO SPACE Explains Kepler's Laws of planetary motion, telescopic Astronomy and experiments with the pendulum.
Sagan, Carl	THE COSMIC CONNECTION
	COSMOS
	INTELLIGENT LIFE IN THE UNIVERSE
	PLANETS
Shimek, William J.	CELLSIUS THERMOMETER Explains how thermometers work.
Sloat, Frank and James	PIONEERS IN SCIENCE
Stambler, Irwin	ORBITING STATIONS, STOPOVERS TO SPACE
Taylor, L.B.	SPACE SHUTTLE How to live in outer space.
Wayne, Bennett	WOMEN WHO DARED TO BE DIFFERENT Women in Science.
Woods, Harold and Geraldine	IS THERE LIFE ON OTHER PLANETS

Reference Encyclopedias:

Most of these reference books may be found in the reference room at the public library.

Astronomy Handbook, by Arthur Beer 1975.
The Cambridge Encyclopedia of Astronomy, by Lloyd Motz 1977.
The Complete Beginners Guide to Microscopes and Telescopes, by Aaron E. Klein.
Encyclopedia of Astronomy and Space, by Ian Ridpath 1979.
The New Space Encyclopedia, by Sir Bernard Lovell 1973.
Space Sciences, Western Space Congress 1970.
(Vandenburg Scientific and Technical Societies Council)
Yearbook of Astronomy, 1980, by Patrick Moore.

Periodicals:

Children's:

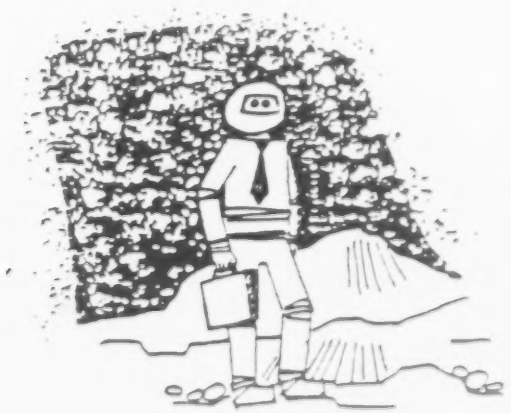
"Odyssey Magazine"
411 E. Mason St.
P.O. Box 92788
Milwaukee, Wisconsin 53202

Adult:

"Mercury"
Journal of the Astronomical Society of the Pacific
1290 24th Avenue
San Francisco, California 94122

"Scientific American"
Amature Scientist
415 Madison Ave.
New York, New York

"Sky & Telescope"
40 Bay State Road
Cambridge, Mass. 02238



Planetariums and Observations

Barringer Meteor Crater
Winslow, Arizona

Center for Meteorite Studies
Arizona State University
Tempe, Arizona
(Contains collection from the Barringer Crater)

Flanarau Planetarium
Tucson, Arizona

Kitt Peak
Tucson, Arizona
(Telescope is 60 miles west of Tucson)

Sacramento Peak Observatory
Sunspot, New Mexico 88349

Stanford Radio Astronomy Institute
Palo Alto, California 94305
(visit by appointment)

Smithsonian Institution, National Air and Space Museum
Washington, D.C.

United States Naval Observatory
Washington, D.C. 20390

Burke Baker Planetarium
Houston Museum of Natural Science
P.O. Box 8175
Houston, TX 77004

Organizations

Astronomical Society of the Pacific
1290 24th Ave.
San Francisco, CA 94122

Newspaper Column A.S.P.
1290 24th Ave.
San Francisco, CA 94122

ART SUPPLEMENT

an opportunity to integrate art experiences within an academic content area.

by Stephany Grassinger

While each component... the self-directed learning unit and Exploring the Arts... is a complete and valid learning experience in itself, together they provide a more comprehensive and lasting educational experience for the learner.

The Starry Night by Vincent Van Gogh

Dutch Artist
1853-1890

Vincent Van Gogh's work is more familiar to a wider public today than the work of any other single painter.

LOOK at "The Starry Night".

"The Starry Night" seems to explode, race, and burst but it does not run away. It is built on a great rushing movement from left to right.

DESCRIBE "The Starry Night" discuss . . . .

color texture space line quality

subject matter directional force

attention to detail emotional impact

COMPILE a list of ten words that describe the movement and energy in "The Starry Night".

READ about the life of Vincent Van Gogh. Make a
outline of the major events of his life. Make a li
of vocabulary words that describe Vincent Va
Gogh and his life's work. Using a marking pen
write each word on the front and back of a piec
of colored board.
Make a mobile with your cards.

After reading about Vincent Van Gogh's life, see if yo
can find any of his personality traits expressed i
"The Starry Night".

DO a painting of a starry night. Express your ow
personal feelings through this painting.

After you have completed your painting, look at you
composition. Is it balanced? Does it express you
feelings? Do the colors "speak" to you? Is you
composition interesting? Why?

Express the same idea with torn paper. Use colored
construction paper for the background. Tear othe
colored papers to construct another starry night.

CONTRAST AND COMPARE your two compositions
Discuss the similarities and
differences between them.

How does using different ar
media change the feeling o
a design? Discuss your ar
work with others.